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(54) Title: LICE TREATMENTS AND INSECT REPELLENT BLENDS, LOTIONS, AND SPRAYS

(57) Abstract

Insect repellent blends, lotions, and sprays are provided. The insect repellent blend includes crystalline 3,8 P-menthanediol (Chinese crystal), and at least two of citronella, geraniol, terpineol and rhodinol. For mosquito and tick repellency, the blend is dissolved or dispersed in a conveying medium so that the resulting product preferably has weight percentages of approximately 0.05 % citronella, approximately 0.06 % geraniol, approximately 0.08 to 0.5 % crystalline 3,8 P- menthanediol approximately 0.06 % terpineol and/or approximately 0.08 % rhodinol. For lice treatment, the blend is preferably dissolved or dispersed in a water based conveying medium so that the resulting product has weight percentages of approximately 0.36 % citronella, approximately 0.43 % geraniol, approximately 2 % crystalline 3,8 P-menthanediol, approximately 0.43 % terpineol and/or approximately 0.57 % rhodinol.

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# LICE TREATMENTS AND INSECT REPELLENT BLENDS, LOTIONS, AND SPRAYS

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates generally to insect repellents including lice treatments. More particularly, the present invention relates to synergistic blends of natural insect repellents which can be used in a carrier as an insect repellent lotion or spray or lice treatment. The repellent blends when carried by a carrier are useful on humans and animals as non-toxic lotions, sprays, and treatments with the repellents being particularly efficacious (although not limited thereto) in repelling mosquitos and in repelling and/or killing lice, and arresting development of lice eggs (nits).

### 2. State of the Art

In an attempt to repel insects, people have turned to widely marketed lotions and sprays which contain N,N-diethyl-m-toluamide (DEET) as their active ingredient. While DEET is an effective repellent, it is not particularly pleasing in smell, may sting when applied, and it has a number of harmful side-effects to humans. DEET is injurious to eyes, mucous membranes, and sensitive skin, and because it is absorbed through the skin, toxic systemic reactions may result as well. Thus, there have been reports of seizures which were believed to be associated with the topical application of DEET. Other symptoms and maladies associated with repeated exposure to DEET have included irritability, confusion, insomnia, encephalopathy, and coma. As a result, cautionary statements regarding use of DEET have been issued by state agencies.

The potential hazards of using a product with DEET as an active ingredient suggests that there exists a great need for a comparably repellent product that is not dangerous to its users.

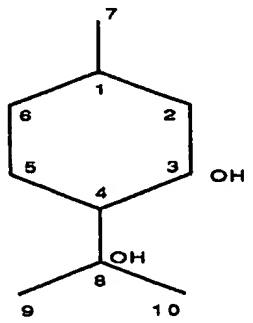
It is known that various herbal and floral extracts are useful in repelling insects. For example, oil of citronella (hereinafter referred to as "citronella"), is widely known as an insect repellent, although it is not nearly as effective as DEET.

Co-owned U.S. Patents #5,227,406 and #5,346,922 which are hereby incorporated by reference herein disclose a non-toxic, generally natural insect repellent which includes terpineol ("T"), citronella ("C"), and one or both of rhodinol extra ("R") and geraniol ("G") as active ingredients provided in a conveying medium. The active ingredients are preferably used in small percentages, e.g. as little as .01%, preferably at between .05% and .08%, and preferably less than 1%, yet are synergistically efficacious, particularly against mosquitos and possibly against other insects such as Lyme-disease carrying ticks. The conveying medium can be among other things, a cosmetic moisturizer lotion, with or without a sun screen. For a spray, the conveying medium can be water or alcohol based. An attractive non-interfering fragrance is preferably provided as approximately .4% of the insect repellent product, and is capable of masking (to humans) the fragrances of the actives because they are present in low concentrations. The lotion or spray is safely applied in liberal quantities to humans and animals without unpleasant side effects such as stinging. It was discovered in controlled studies that the combination of the T, C, G, and R ingredients is effective because of a synergistic interaction among the ingredients and that the sub-combination of T, C, and R, or T, C, and G are also synergistic. Best results were obtained with a repellent having the following concentrations of ingredients: .06% T, .05% C, .08% R, and .06% G.

There have been reports in the literature that a plant derivative known as "Chinese crystal" is also an effective herbal insect repellent. Chinese crystal, a naturally occurring component of an essential oil obtained from China, is available from Shaw Mudge & Company, Stamford, CT under the name "Chinese

Botanical I". It is a crystalline compound commonly referred to as 3,8 P Menthanediol (also known as 2-hydroxy a,a,4 trimethyl cyclohexane methanol) and has a molecular structure as shown below in Diagram 1.

DIAGRAM 1




## SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide effective and safe insect repellent blends and repellents comprising the blends and conveying media. Other objects of the invention include: to provide effective insect repellent blends which are dispersed or dissolved in or used in conjunction with different conveying media such as lotions, sprays, or the like; to provide an effective insect repellent which has an attractive fragrance; to provide insect repellent blends, sprays, and lotions which effectively repels mosquitos and other insects, and which effectively repels lice and arrests the development of lice nits; to provide a safe, effective insect repellent blend in a conveying medium which can be applied liberally to one or more of the face, skin, hair, and clothing of a person; to provide safe and effective insect repellents for animals; to provide an insect repellent or lice treatment which utilizes generally safe herbal and floral extract ingredients or the natural oils that contain them, but which achieves an efficacy comparable to DEET; and to provide an insect repellent which may be impregnated into a

fabric or plastic, incorporated into a sprayable mist, and be used in other applications such as surface treatments.

In accordance with the objects of the invention, an insect repellent blend is provided which includes Chinese crystal (CC), and at least two of citronella (C), geraniol (G), terpineol (T) and rhodinol (extra) (R). For repellency of insects such as mosquitos or ticks, the repellent blend preferably comprises from about 5% -25% by weight C, from about 5% - 25% by weight G, from about 30% -75% by weight CC, and T and/or R each being from about 5% - 30% by weight, such that the components of the blend total 100% by weight. The blend is typically dispersed or dissolved in a conveying medium such as a lotion, spray, or the like. When so dispersed or dissolved, the concentration of the components in the overall formulation generally ranges from about 0.01 to 1 weight percent each of C, G and T and/or R, and 0.01 to 5 weight percent CC, with the balance comprising the conveying medium. The conveying medium may include one or more of moisturizers, sunscreen, fragrances, and other ingredients if desired.

In accord with another aspect of the invention, the insect repellent blend which includes CC, and at least two of C, G, T and R is used in higher concentrations (e.g., greater than 1%, and preferably 2%- 5% of an overall formulation) as a lice treatment. In a particularly preferred embodiment, an insect repellent blend for lice treatment includes approximately 7% citronella, approximately 9% geraniol, approximately 9% terpineol, and approximately 75% Chinese crystal. The blend is then provided in a carrier, with the blend constituting approximately 4% by weight of the formulation. The preferred carrier is a "leave in" hair and skin conditioner spray which includes water, a hair and skin conditioner(s), a humectant(s), a lubricant(s), a preservative(s), and an emulsifier(s).

Additional objects and advantages of the invention will become apparent to those skilled in the art upon reference to the detailed description taken in conjunction with the provided figures.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a bar graph showing mean repellency, as a percentage of biting rates observed in a control, for each of the embodiments of the invention tested for mosquito repellency and for each of the ingredients of the invention;

Figure 2 is a graph of the 95% confidence intervals and the narrow sense additivity model for one embodiment of the invention;

Figure 3 is a graph of the 95% confidence intervals and the narrow sense additivity model for another embodiment of the invention;

Figure 4 is a graph of the 95% confidence intervals and the narrow sense additivity model for an additional embodiment of the invention; and

Figure 5 is a graph of the 95% confidence intervals and the narrow sense additivity model for yet another embodiment of the invention.

Figures 6a-6f are graphs showing amounts of live nits and lice, and dead nits and lice in six subjects of a test over periods of several days.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The insect repellent blend according to the invention includes a combination of Chinese crystal, and at least two of citronella, geraniol, and terpineol or rhodinol (extra).

Preferably, the blend includes CC, C, G, and T and/or R. The blend is typically dispersed or dissolved in a conveying medium such as a lotion, spray, or the like. For purposes of mosquito repellency, four embodiments of the invention were tested as were the individual constituents of each embodiment and a control. Table 1 lists the various constituents (items 1-6) of the embodiments of the invention and their concentration as a weight percentage in a carrier of fragrance-free Lubriderm™ skin lotion. Table 1 also lists the four embodiments of the invention (items 7-10) indicating the concentration of the active ingredients of each embodiment as a weight percentage in a carrier of fragrance-free Lubriderm™ skin lotion. The first two embodiments, Combination 1A (item 7 in Table 1) and Combination 1B (item 8 in Table 1), have CC, C, G and T as ingredients and differ only in their concentration of CC, 0.5% versus .08%. The second two embodiments, Combination 2A (item 9 in Table 1) and Combination 2B (item 10 in Table 1), have CC, C, G, and R as ingredients and differ only in their concentration of CC, 0.5% versus .08%. Item 11 in Table 1, 100% fragrance-free Lubriderm™, was also tested as a control.

TABLE 1: List of Constituents, Combinations, and Control

| Constituent | | Concentration (%) |
|---|---|---|
| 1) Citronella | | 0.05 |
| 2) Geraniol | | 0.06 |
| 3) Rhodinol Extra | | 0.08 |
| 4) Terpineol | | 0.06 |
| 5) Chinese Crystal | | 0.08 |
| 6) Chinese Crystal | | 0.5 |
| 7) Combination 1A: | | |
| | Chinese Crystal | 0.5 |
| | Citronella | 0.05 |
| | Geraniol | 0.06 |
| | Terpineol | 0.06 |
| 8) Combination 1B: | | |
| | Chinese Crystal | 0.08 |
| | Citronella | 0.05 |
| | Geraniol | 0.06 |
| | Terpineol | 0.06 |
| 9) Combination 2A: | | |
| | Chinese Crystal | 0.5 |
| | Citronella | 0.05 |
| | Geraniol | 0.06 |
| | Rhodinol Extra | 0.08 |
| 10) Combination 2B: | | |
| | Chinese Crystal | 0.08 |
| | Citronella | 0.05 |
| | Geraniol | 0.06 |
| | Rhodinol Extra | 0.08 |
| 11) Fragrance-free Lubriderm™ Control | | 100 |

Each of the constituents, combinations, and control in Table 1 was tested by treating a human hand with 1cc of the treatment and subjecting the treated hand to attack by Aedes aegypti

mosquitos. The mosquitos were held in captivity in cubic Plexiglas™ cages (0.3 meters per side), with 200 mosquitos per cage, maintained on sugar water. Trials were conducted by placing the treated hand into a cage and counting the number of bites during a 15 second period. Testing was conducted for 110 trials for each the constituents, combinations, and control ("treatments"). Seven subjects participated in the testing. Hands were washed thoroughly with unscented soap between trials. The treatments were tested one after the other with the order randomized between trials. The number of bites on a control treated hand during a 15 second period varied from 5-33 over the 110 trials of the control, with a mean of 17.33, and a standard deviation of 6.65. Data from the 1,210 trials were pooled among subjects for analysis. The means and the 95% confidence intervals for each treatment were calculated. The 95% confidence interval is the range, estimated from the data, within which the next hypothetical data point collected from the same experiment would be expected to occur in 95% of the cases. Table 2 shows the calculated results for each treatment as a percentage of the biting rate of the control treatment. It will be understood that a lower percentage represents a higher repellency.

TABLE 2: Repellency Mean Values and 95% Confidence Intervals for Each Constituent and Combination Treatment Expressed as a Percentage of the Biting Rate of the Control Treatment

| Treatment | Lower 95% C.I. | Mean | Upper 95% C.I. |
|---|---|---|---|
| 1) Citronella .05% | 69.8 | 81 | 91.4 |
| 2) Geraniol .06% | 73 | 81.5 | 90 |
| 3) Rhodinol Extra .08% | 73 | 82 | 90 |
| 4) Terpineol .06% | 74 | 85 | 95 |
| 5) Chinese Crystal 0.5% | 45.4 | 52.6 | 59.8 |
| 6) Chinese Crystal 0.08% | 60 | 67.1 | 74.3 |
| 7) Combination 1A (CC 0.5%) | 9.2 | 11.3 | 13.4 |
| 8) Combination 1B (CC 0.08%) | 14.8 | 17.7 | 20.7 |
| 9) Combination 2A (CC 0.5%) | 10.3 | 13.1 | 15.8 |
| 10) Combination 2B (CC 0.08%) | 13.3 | 17.7 | 22.0 |

As shown in Table 2, the mean repellency rate of C, G, R, and T when tested individually, varied from 81-85% of the biting rate of the control. CC (lines 6 and 7), exhibited a better repellency rate of about 52-67% of the biting rate of the control. Each of the combinations (lines 7-10) exhibited a dramatically better repellency rate than any of the ingredients, i.e. about 11-18% of the biting rate of the control.

The mean values shown in Table 2 are shown graphically in Figure 1. Referring to Table 2 and Figure 1, it can be seen that the most effective treatment was Combination 1A (line 7 of Table 2 and Figure 1) which contained approximately .06% T, approximately .05% C, approximately .06% G, and approximately 0.5% CC, exhibiting a mean repellency rate of 11.3%. Combination 2A (line 9 of Table 2 and Figure 1) which contained approximately .08% R, approximately .05% C, approximately .06% G, and approximately 0.5% CC, was almost as effective, exhibiting a mean repellency rate of 13.1%. Combination 1B (line 8 of Table 2 and Figure 1) which contained approximately .06% T, approximately

.05% C, approximately .06% G, and approximately .08% CC, and Combination 2B (line 10 of Table 2 and Figure 1) which contained approximately .08% R, approximately .05% C, approximately .06% G, and approximately .08% CC, had the same mean repellency rate of 17.7%. These findings suggest that an increased concentration of Chinese crystal significantly increases repellency and that the contribution of rhodinol extra is substantially identical to the contribution of terpineol.

The analyzed data from the 1,210 trials were examined using the model of factorial additivity. Under this model, the mean and 95% confidence interval for each ingredient of each combination were combined multiplicatively. The resulting mean and "narrow sense additivity" predicts a mean and a confidence interval which would be expected of the combination if the contribution of each ingredient were simply "additive".

The expected mean repellency of Combination 1A, therefore, is calculated by multiplying the observed mean repellency rates of each of the ingredients of Combination 1A. Referring to Table 2, it will be appreciated that the expected mean repellency of Combination 1A is 29.52% = (81% * 81.5% * 85% * 52.6%). Similarly, the expected 95% confidence interval (narrow sense additivity) for Combination 1A is 17.12% to 46.73%. It will be appreciated, however, that the observed mean repellency of Combination 1A was actually 11.3% which is much lower than the expected rate of 29.52%. In addition, the confidence interval of the observed treatment of Combination 1A (9.2% to 13.4%) is well below the expected confidence interval of 17.2% to 46.73%. The comparison of the observed mean and confidence interval for Combination 1A and the expected mean and narrow sense additivity is shown graphically in Figure 2. The fact that there is no overlap between the confidence interval of Combination 1A and the narrow sense additivity model indicates that there is a statistically significant difference (of at least $P<0.05$) between the model and the data accumulated for Combination 1A. In other

words, it is at least 95% probable that the interaction among the ingredients of Combination 1A is synergistic rather than merely additive.

The same analysis was applied to the data accumulated for Combination 1B and is represented graphically in Figure 3. Referring to Table 2, it will be appreciated that the expected mean repellency of Combination 1B is 37.65% = (81% * 81.5% * 85% * 67.1%). The expected 95% confidence interval (narrow sense additivity) for Combination 1B is 22.62% to 58.06%. It will be appreciated, however, that the observed mean repellency of Combination 1B was actually 17.7% which is much lower than the expected rate of 37.65%. In addition, the confidence interval of the observed treatment of Combination 1B (14.8% to 20.7%) is well below the expected confidence interval of 22.62% to 58.06% with no overlap. It is, therefore, at least 95% probable that the ingredients of Combination 1B act synergistically rather than additively.

Turning now to Figure 4, and with reference to Table 2, the expected mean repellency of Combination 2A is 28.47%. The expected 95% confidence interval (narrow sense additivity) for Combination 2A is 18.69% to 44.27%. It will be appreciated, however, that the observed mean repellency of Combination 2A was actually 13.1% which is much lower than the expected rate of 28.47%. In addition, the confidence interval of the observed treatment of Combination 2A (10.3% to 15.8%) is well below the expected confidence interval of 18.69% to 44.27% with no overlap. It is, therefore, at least 95% probable that the ingredients of Combination 2A act synergistically rather than additively.

The same analysis was applied to the data for Combination 2B and is demonstrated graphically in Figure 5. The observed mean repellency of Combination 2B was actually 17.7% which is much lower than the expected rate of 36.32%. In addition, the confidence interval of the observed treatment of Combination 2B

(13.3% to 22.0%) is below the expected confidence interval of 22.32% to 55.01% with no overlap. It is, therefore, at least 95% probable that the ingredients of Combination 2B act synergistically rather than additively.

Based on the above observations and analyses, it is concluded that each embodiment of the invention represents a synergistic interaction of ingredients. The mean repellency rates of each of the embodiments of the invention averaged two times better than what was predicted by the factorially additive model. In addition, the 95% confidence intervals predicted from the additivity models do not overlap those calculated for the observed performance of the embodiments of the invention. Thus, the actual performance of the embodiments of the invention is significantly superior to the performance predicted had there been no synergy among the ingredients. It is also worth noting that the performance of the embodiments of the invention was significantly less variable than the performance of the individual ingredients as indicated by the significantly narrower confidence intervals listed in Table 2. It is believed that the greater repellency of Combinations 1A and 2A as compared to Combinations 1B and 2B was due to the higher concentration of Chinese crystal, which was the most repellent of the individual constituents. It is also believed that the similar results obtained with Combinations 1A and 2A verses 1B and 2B was due to the similar repellency of terpineol and rhodinol extra. It is further believed that similar results are obtained when the active components of the insect repellent blend are employed with or without a conveying medium. Further yet, it is believed that combinations of CC with any two out of the four other actives will also exhibit synergistic results.

It is also noted that the tests reported herein were conducted using a species (Aedes aegypti) of mosquito which is widely maintained in laboratory colonies. This species is known to be more aggressive (less repelled) than other species. While

no representations have been made regarding efficacy in the field, it is possible that even greater repellency may be observed with other species.

Further, it should be noted that the concentrations of citronella, geraniol, terpineol, and rhodinol extra used in the embodiments disclosed are the optimal concentrations of these ingredients disclosed in the above-referenced co-owned U.S. Patents #5,227,406 and #5,346,922. However, it is believed that the concentrations of these ingredients in the present invention could range significantly, up to and beyond the 1% described in co-owned U.S. Patents #5,227,406 and #5,346,922. In addition, it is believed that concentrations of Chinese crystal up to and beyond 5% in the overall formulation may be useful, as larger amounts of Chinese crystal are readily masked by non-interfering fragrances.

Further yet, it should be appreciated that while a preferred conveying medium for the insect repellent of the invention has been described, the conveying medium may take many forms. For example, the insect repellent of the invention may be incorporated into mediums including, but not limited to lotions, sprays, creams, soaps (liquid or bar), powders, candles, perfumes, etc. In fact, other active ingredients for other purposes, such as suntanning, sunscreening, sun-blocking, skin moisturizing, etc. can be added to the lotions, sprays, creams, soaps, powders, candles, perfumes, etc. Likewise, the insect repellent may be impregnated into a fabric or plastic in manners known in the art in which other repellents are impregnated into fabrics or plastics, thus effectively causing the fabric or plastic to become the conveying medium. Likewise, the insect repellent of the invention may be used in other applications such as surface treatments such as by incorporating the repellent into a wax or other surface coating.

Also, it should be noted that while the described embodiments were described for use on human skin for effectively

repelling mosquitos, the insect repellent is believed to repel other insects (as discussed below with reference to Figs. 6a-6f), and may be used on animals as well as humans.

In accord with another aspect of the invention, the insect repellent blend which includes CC, and two or more of C, G, T and R may be used in higher concentrations (e.g., greater than 1%, and preferably 2%- 5% of an overall formulation) as a lice treatment. In a particularly preferred embodiment, an insect repellent blend for lice treatment includes approximately 7% citronella, approximately 9% geraniol, approximately 9% terpineol, and approximately 75% Chinese crystal. The blend is then provided in a carrier, with the blend constituting approximately 3% by weight of the formulation. The preferred carrier is a "leave in" hair and skin conditioner spray which includes water, a hair and skin conditioner(s), a humectant(s), a lubricant(s), a preservative(s), and an emulsifier(s). The conditioners act to condition the hair (and skin) by bonding to proteins of the hair (and skin). The humectants act to hold water (including the insect repellent blend which is emulsified and/or dissolved in the water) on the hair. The lubricants act to lubricate the hair so as to permit easier combing. The preservatives act to preserve proteins which may be contained in the conditioners. The emulsifiers act to emulsify the insect repellent blend as well as the lubricant and other carrier ingredients in the water.

In accord with the lice treatment aspect of the invention, an insect repellent blend for lice treatment was prepared having approximately 7% C, approximately 9% G, approximately 9% T, and approximately 75% CC by weight. The blend in conjunction with an aroma mask was then added to a water based sprayable medium (carrier) to create a formulation. The carrier utilized was a "leave in" hair conditioner spray which included water, hair and skin conditioners, humectants, a lubricant, a preservative, and

emulsifiers which are all known in the art. The ingredients of the formulation by weight was approximately:

| | | | |
|---|---|---|---|
| water: | 91.41% | conditioners: | 2.53% |
| humectants: | 1.59% | lubricants: | 0.12% |
| preservatives: | 0.11% | emulsifiers: | 0.99% |
| aroma mask: | 0.33% | repellent blend: | 3.22% |

Using the prepared lice treatment formulation, a first study on six subjects was conducted using the following basic protocol. On day 1, the rear of the hair scalp of each subject was sampled for nits and lice by combing twenty times, and the combings were saved for microscopic examination to determine numbers of live and dead nits and lice. The lice treatment conditioner was applied as a spray to the hair until the hair was moistened thoroughly. On days 3 and subsequent, the hair was recombed, the combings saved and examined, and conditioner reapplied as above. The six subjects were told to apply conditioner and comb daily during the study, although only two subjects made additional applications.

Before turning to Figs. 6a-6f, it is noted that the numbers contained therein are samples, not absolute population measures. In addition, some of the subjects were living in homes in which both the environment and other family members were infested, so lice could have been acquired after initiation of treatment. Further, it is noted that louse eggs take 7-11 days to hatch, and maturation occurs about eight days after that.

Turning now to Figs. 6a-6f, it is seen that information was gathered on each subject on days 1, 3, 5, and in the case of subject #1 (Fig. 6a), on day 10. It is noted that in almost all cases, on day 1 there were no dead nits (except subject #6) and there were live lice (except subject #4) and live nits (except subject #5). By day 3, the live lice had been eradicated in subjects #1, #2, and #6, although in subject #1, the lice reappeared on day 5 and were eradicated by day 10. In addition,

by day 5, the live lice and live nits were eradicated in all subjects except subject #1 where they were eradicated by day 10.

The following additional observations regarding the first lice study were made. The combing and the use of the lice treatment reduced louse populations on the subjects to zero, and all six subjects remained louse free at least two weeks after the completion of the graphed study. Combing itself was most certainly not responsible for the elimination of infestation because not all of the hair/scalp was combed, and because twenty combings is a low number from the standpoint of thoroughness. Many lice responded to the lice treatment by moving away from the scalp, and thus were easier to comb out. In addition, as reported by all of the subjects who had prior experience with louse removal, application of the lice treatment spray made nits easier to remove by combing and with fingers.

Using the prepared lice treatment, a second study was conducted where a gravid female louse was induced to lay nine eggs on the arm hairs of a researcher. Five of these lice were treated with the conditioner, while the four other eggs remained untreated. Eggs were held separately in petri dishes with filter paper floors. All untreated eggs showed normal development. All treated eggs failed to develop.

The lice studies suggests that control is gained at least in part through egg mortality (ovicidal action). The absence of subsequent infestations in the six subjects of the first study indicates that no live eggs were present at the time the applications were terminated and that the use of the lice treatment may discourage reinfestation, perhaps over substantial periods of time after cessation of the lice treatment application.

There have been described herein synergistic insect repellent blends which incorporate Chinese crystal, citronella,

geraniol, and either terpineol or rhodinol (extra), which can be dispersed or dissolved in a conveying medium such as a lotion or spray, such that the blend comprises a small percentage of the conveying medium. While particular embodiments have been described, it is not intended that the invention be limited thereto, as it is intended that the invention be as broad in scope as the art will allow. Thus, while preferred percentages and ranges of actives were described, it will be appreciated that different relative percentages of the active ingredients within and outside those preferred ranges could be utilized, although it is not known whether the resulting combination would be as efficacious as the preferred embodiments. In addition, while the insect repellents were tested and proved to be effective on mosquitos and lice, it is believed the repellent has efficacy on other insects, including ticks. Therefore, it will be appreciated by those skilled in the art that yet other modifications could be made to the provided invention without deviating from its spirit and scope as so claimed.

Claims:

1. An insect repellent, comprising:
a blend of crystalline 3,8 P-menthanediol, and at least two of citronella, geraniol, terpineol and rhodinol.

2. An insect repellent according to claim 1, wherein:
said at least two of citronella, geraniol, terpineol, and rhodinol comprises citronella, geraniol, and terpineol and/or rhodinol.

3. An insect repellent according to claim 2, wherein:
said geraniol comprises from about 5% to 25% by weight of said blend,
said citronella comprises from about 5% to 25% by weight of said blend,
said crystalline 3,8 P-menthanediol comprises from about 30% to 75% by weight of said blend, and
said terpineol and/or rhodinol comprises from about 5% to about 50% by weight of said blend.

4. An insect repellent according to claim 1, further comprising:
a conveying medium, wherein said blend is dispersed, dissolved, or otherwise carried in said conveying medium.

5. An insect repellent according to claim 2, further comprising:
a conveying medium, wherein said blend is dispersed, dissolved, or otherwise carried in said conveying medium, wherein
said geraniol constitutes at least .01% of the insect repellent,
said citronella constitutes at least .01% of the insect repellent,
said terpineol and/or rhodinol constitutes at least .01% of the insect repellent, and
said crystalline 3,8 P-menthanediol constitutes at least .01% of the insect repellent,

wherein all listed percentages (%) are weight percentages.

6. An insect repellent according to claim 5, wherein:
said geraniol constitutes no more than 1% of the insect repellent;
said citronella constitutes no more than 1% of the insect repellent;
said terpineol and/or rhodinol constitutes no more than 2% of the insect repellent;
said crystalline 3,8 P-menthanediol constitutes no more than 5% of the insect repellent,
wherein all listed percentages (%) are weight percentages.

7. An insect repellent according to claim 5, wherein:
said geraniol constitutes about 0.01% to 1% by weight of said insect repellent,
said citronella constitutes about 0.01% to 1% by weight of said insect repellent,
said 3,8 P-menthanediol constitutes about 0.01% to 5% by weight of said insect repellent,
said terpineol and/or rhodinol constitutes about 0.01% to 2% by weight of said insect repellent,
said conveying medium comprises the balance of said insect repellent.

8. An insect repellent according to claim 7, wherein:
said 3,8 P-menthanediol constitutes approximately 0.08% of said insect repellent.

9. An insect repellent according to claim 7, wherein:
said 3,8 P-menthanediol constitutes approximately 0.5% of said insect repellent.

10. An insect repellent according to claim 7, wherein:
said 3,8 P-menthanediol constitutes approximately 1% to 3% of said insect repellent.

11. An insect repellent according to claim 8, wherein:
said geraniol constitutes approximately 0.06% of said insect repellent, said citronella constitutes approximately 0.05% of said insect repellent, and said terpineol and/or rhodinol constitutes approximately 0.06% to .014% of said insect repellent.

12. An insect repellent according to claim 9, wherein:
said geraniol constitutes approximately 0.06% of said insect repellent, said citronella constitutes approximately 0.05% of said insect repellent, and said terpineol and/or rhodinol constitutes approximately 0.06% to .014% of said insect repellent.

13. An insect repellent according to claim 10, wherein:
said geraniol constitutes approximately .4% of said insect repellent, said citronella constitutes approximately .4% of said insect repellent, said terpineol and/or rhodinol constitutes approximately .4% to 1% of said insect repellent, and said 3,8 P-menthanediol constitutes approximately 2% of said insect repellent.

14. An insect repellent according to claim 4, wherein:
said insect repellent is suitable for use on human skin.

15. A lice treatment, comprising:
a blend of crystalline 3,8 P-menthanediol, and at least two of citronella, geraniol, terpineol and rhodinol all carried in a carrier.

16 A lice treatment according to claim 15, wherein:
said at least two of citronella, geraniol, terpineol, and rhodinol comprises citronella, geraniol, and terpineol and/or rhodinol.

17. A lice treatment according to claim 16, wherein:
said geraniol constitutes about 0.01% to 1% by weight of said lice treatment,
said citronella constitutes about 0.01% to 1% by weight of said lice treatment,
said 3,8 P-menthanediol constitutes about 0.01% to 5% by weight of said lice treatment,
said terpineol and/or rhodinol constitutes about 0.01% to 2% by weight of said lice treatment,
said conveying medium comprises substantially the balance of said lice treatment.

18. A lice treatment according to claim 16, wherein:
said carrier is a water based sprayable medium.

19. A lice treatment according to claim 18, wherein:
said carrier comprises water, a hair conditioner, a humectant, and an emulsifier.

20. A lice treatment according to claim 19, wherein:
said conveying medium further comprises a lubricant and a preservative.

21. A lice treatment according to claim 19, wherein:
said carrier further comprises an aroma mask which substantially masks the scents of said geraniol, said citronella, said 3,8 P-menthanediol, and said terpineol and/or rhodinol to humans.

22. A method of treating lice, comprising:
treating a lice infested area with a treatment comprising crystalline 3,8 P-menthanediol, and at least two of citronella, geraniol, terpineol and rhodinol, all carried in a carrier.

23. A method according to claim 22, wherein:

said carrier is a water based carrier, and said treating comprises wetting the lice infested area with said treatment.

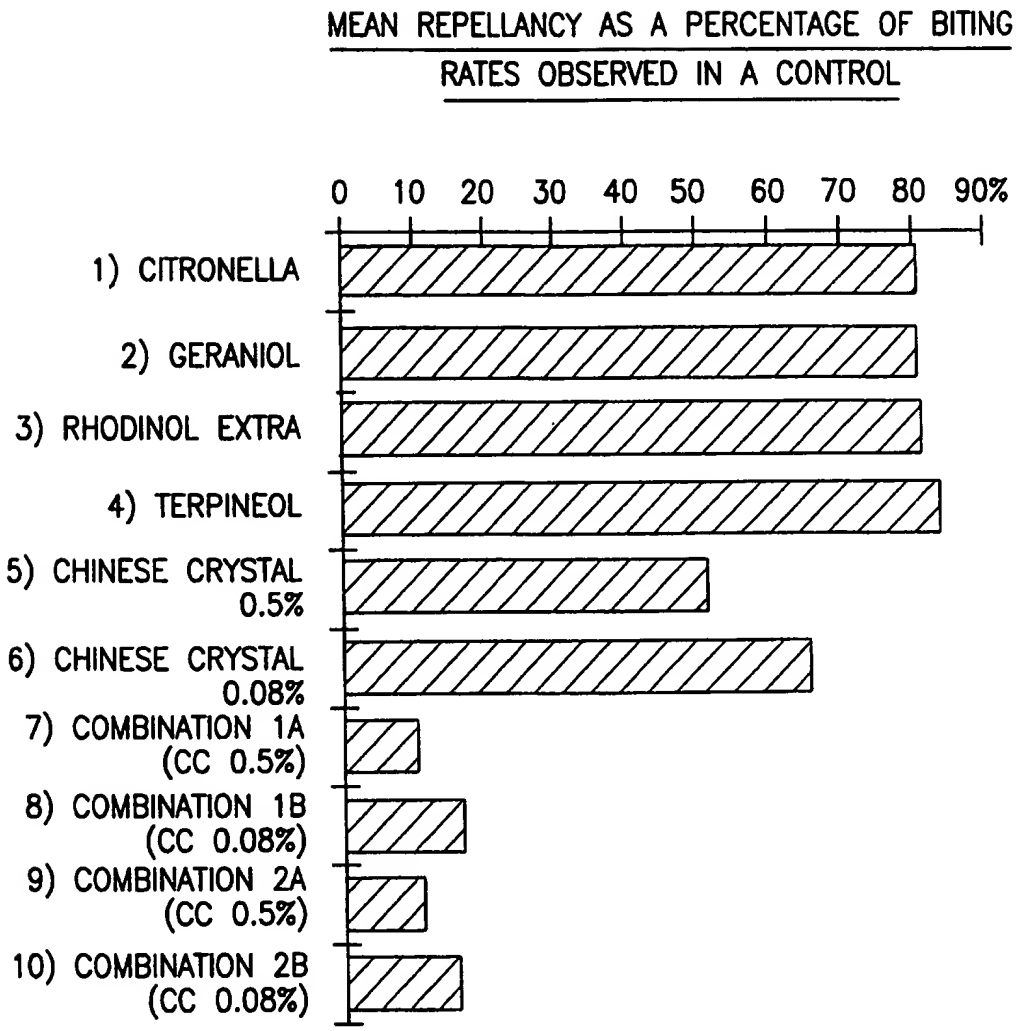

MEAN REPELLANCY AS A PERCENTAGE OF BITING RATES OBSERVED IN A CONTROL
0 10 20 30 40 50 60 70 80 90%
1) CITRONELLA
2) GERANIOL
3) RHODINOL EXTRA
4) TERPINEOL
5) CHINESE CRYSTAL 0.5%
6) CHINESE CRYSTAL 0.08%
7) COMBINATION 1A (CC 0.5%)
8) COMBINATION 1B (CC 0.08%)
9) COMBINATION 2A (CC 0.5%)
10) COMBINATION 2B (CC 0.08%)

FIG.1

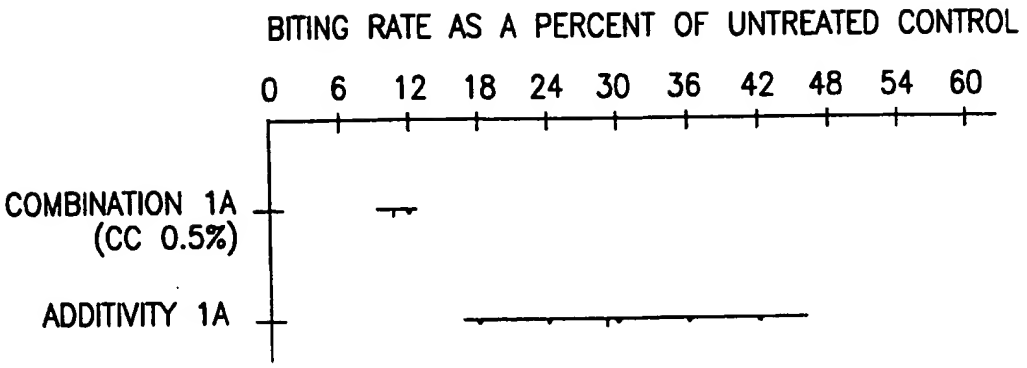

BITING RATE AS A PERCENT OF UNTREATED CONTROL
0 6 12 18 24 30 36 42 48 54 60
COMBINATION 1A
(CC 0.5%)
ADDITIVITY 1A

FIG.2

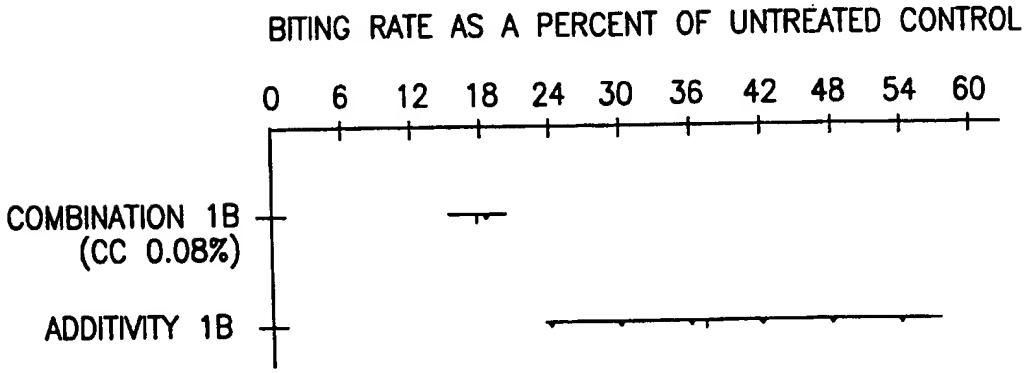

BITING RATE AS A PERCENT OF UNTREATED CONTROL
0 6 12 18 24 30 36 42 48 54 60
COMBINATION 1B
(CC 0.08%)
ADDITIVITY 1B

FIG.3

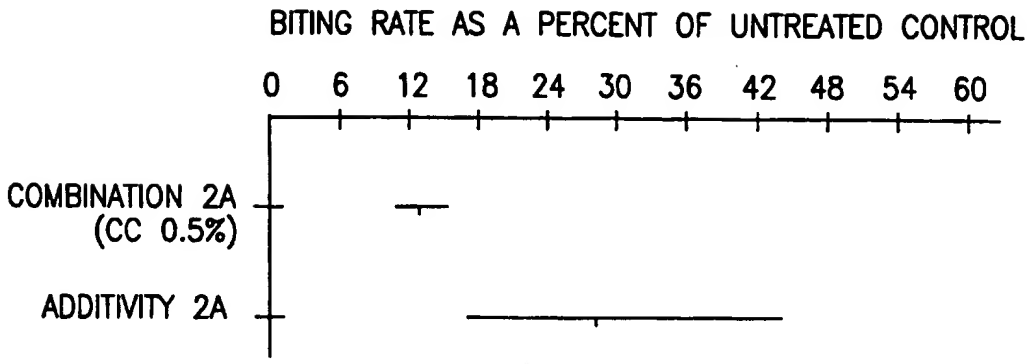

BITING RATE AS A PERCENT OF UNTREATED CONTROL
0 6 12 18 24 30 36 42 48 54 60
COMBINATION 2A
(CC 0.5%)
ADDITIVITY 2A

FIG.4

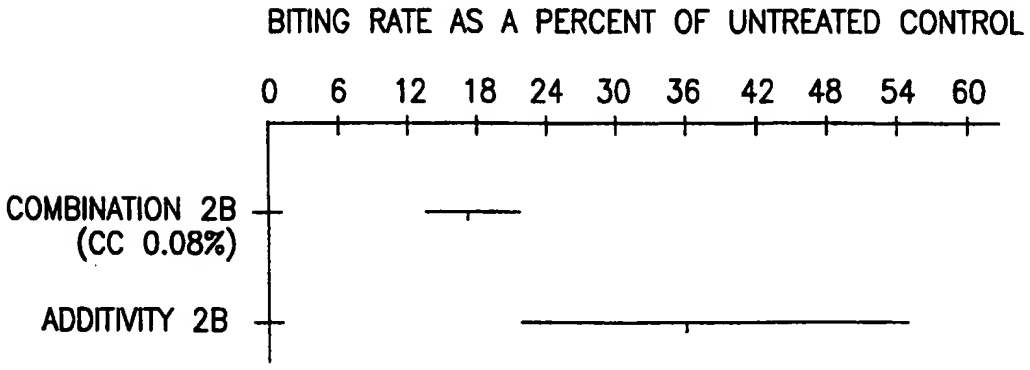

BITING RATE AS A PERCENT OF UNTREATED CONTROL
0 6 12 18 24 30 36 42 48 54 60
COMBINATION 2B
(CC 0.08%)
ADDITIVITY 2B

FIG.5

FIG.6a

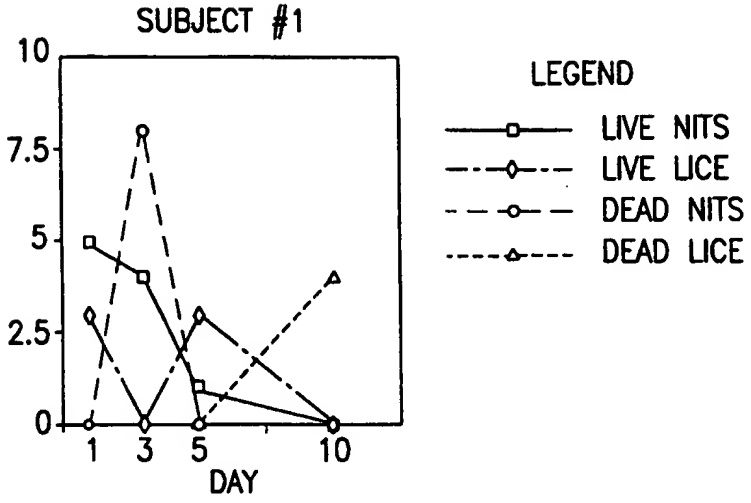



FIG.6b

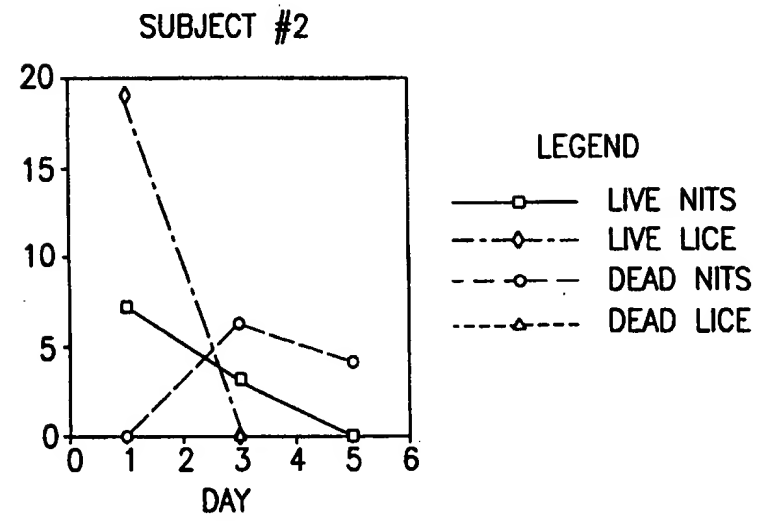



FIG.6c

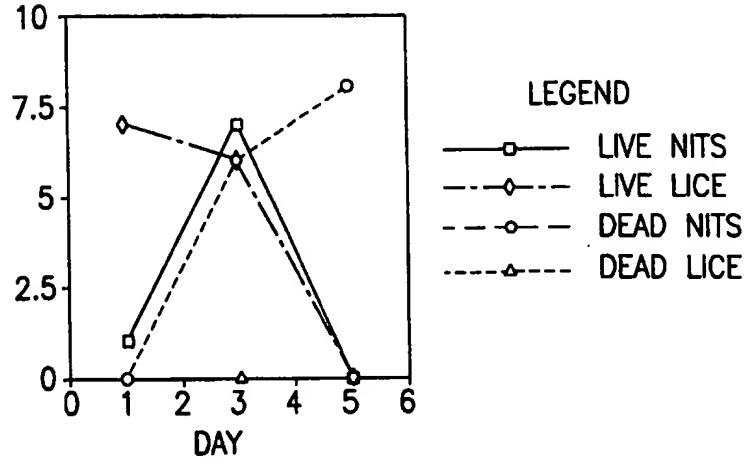


FIG.6d

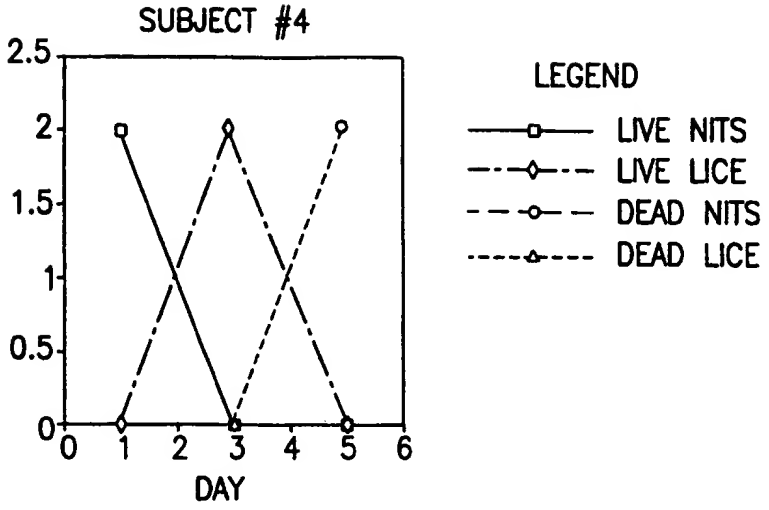



FIG.6e

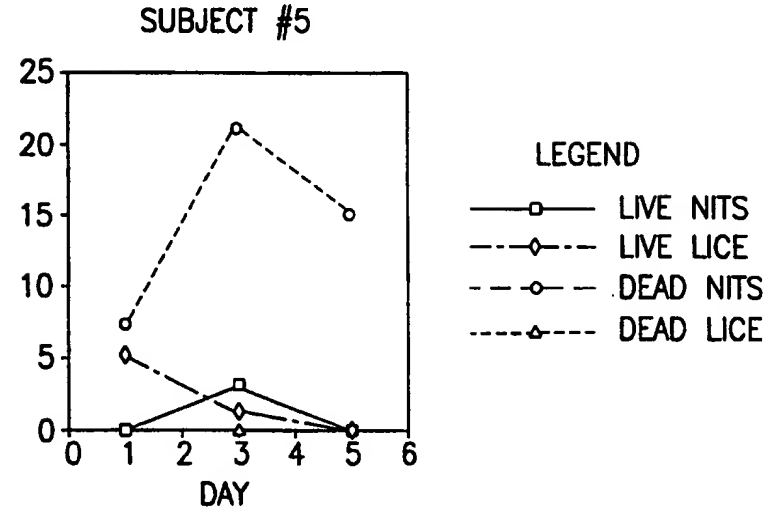
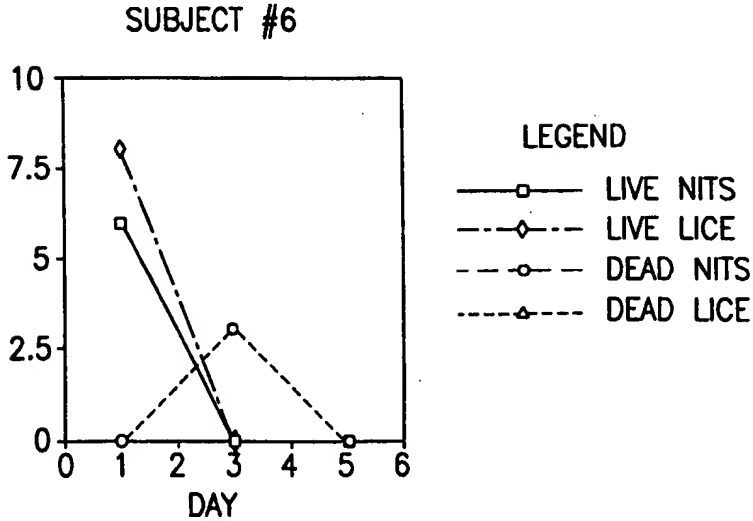



FIG.6f



# INTERNATIONAL SEARCH REPORT

Int. ..tional application No.
PCT/US96/13794

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :A01N 31/02, 31/04, 31/06, 65/00.
US CL :514/703, 729, 739, 919; 424/195.1, DIG.10.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
U.S. : 514/703, 729, 739, 919; 424/195.1, DIG.10.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 5,227,406 A (BELDOCK et al.) 13 July 1993, column 2, lines 10-35. | 1-23 |
| A | US 5,298,250 A (LETT et al.) 29 March 1994, see from column 2, line 40 to column 3, line 35. | 1-23 |
| A | US 5,130,136 A (SHONO et al.) 14 July 1994, column 1, lines 18-66. | 1-23 |
| A | US 5,106,622 A (SHERWOOD et al.) 21 April 1992, column 3, lines 28-68. | 1-23 |

COURTESY

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

| | | | |
|---|---|---|---|
| * | Special categories of cited documents: | "T" | later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
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| "E" | earlier document published on or after the international filing date | "Y" | document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
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| "O" | document referring to an oral disclosure, use, exhibition or other means | | |
| "P" | document published prior to the international filing date but later than the priority date claimed | | |

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 24 SEPTEMBER 1996 | 10 OCT 1996 |
| Name and mailing address of the ISA/US<br>Commissioner of Patents and Trademarks<br>Box PCT<br>Washington, D.C. 20231<br>Facsimile No. (703) 305-3230 | Authorized officer<br>JOHN PAK<br>Telephone No. (703) 308-1235 |

Form PCT/ISA/210 (second sheet)(July 1992)*